

16 July 2004

To: Paul Philp  
DOE Project Manager, Run IIb CDF Detector Project

From: Pat Lukens  
Project Manager for the Run IIb CDF Detector Project

**Subject: Run IIb CDF Detector Project June 2004 Report**

Attached is the monthly report summarizing the June 2004 activities and progress for the Fermilab RunIIb CDF Detector Project. This report is available electronically at:

<http://www-cdf.fnal.gov/run2b.html>

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**RunIIb CDF Detector Project**  
**Progress Report No. 19**  
**1 - 30 June 2004**

## **I. PROJECT DESCRIPTION**

The primary goal of the CDF Run IIb Detector Project is to enable the detector to exploit the physics opportunities available during Tevatron operation through 2008. The data from Run II will represent a set of detailed measurements that can be compared with the predictions of the Standard Model at the highest available collision energy. The increased size of the data sample will allow us to study the top quark by measuring the details of its production and decay mechanism. In addition, we plan precision electroweak and QCD measurements, continued searches for a variety of phenomena that are predicted to exist beyond the Standard Model framework, and to explore CP violation in the  $b$  quark sector. The detailed physics goals of the upgrade are described in the Technical Design Report (TDR).

The major tasks of this upgrade are:

- Upgrade the calorimeter by replacing the Central Preradiator Chamber with a device with shorter response time to allow operation in a high-luminosity environment, and adding timing information to the electromagnetic calorimeters.
- Upgrade the data acquisition and trigger systems to increase throughput needed for higher luminosity operation and efficiently trigger on the higher multiplicity events of Run IIb.

## **II. OVERVIEW OF PROJECT STATUS – P. Lukens**

A Director's review of the project is scheduled for 20-21 July 2004. The charge and agenda are now posted. We are using this review as an internal deadline for any schedule or scope corrections needed for the project.

In internal review of the track trigger upgrade (XFT) was held on 25 June 2004 which was a follow up to the May review. This review presented the new scope for the XFT to the review committee. The cost and schedule details presented there will be proposed for the new baseline XFT at the Director's review.

An internal review of the silicon vertex trigger (SVT) upgrade was held on 29 June 2004. The cost and schedule for the scope of this project was presented here, and forms the basis of the new SVT scope proposal. This will be presented at the Director's review as well.

The final report from the Silicon Longevity committee is near completion. This committee explored possible long-term weaknesses in the silicon detector, and worked to identify any needed replacements. No additions to the Run IIb project scope are planned, based on the recommendations of this study. We anticipate a scope reduction at the time of the Director's review, based on this report.

### III. PROJECT MILESTONE SUMMARY (as of 30 June 2004)

#### CDF Level 2 Schedule Milestones from the Resource Loaded schedules

WBS	Title	Baseline Comp. Date	Forecast/Actual Completion Date	Complete
1.2.1.10.1	First phototube order placed	9-May-03	1-Apr-03	Yes
1.2.2.2.7.1	Prototype Testing Complete	16-May-03	28-Mar-03	Yes
1.2.2.2.7.4	ASD->TDC Cables ready for installation	16-May-03	26-Aug-03	Yes
1.2.2.2.7.2	CEM Splitters ready for installation	19-May-03	29-Jul-03	Yes
1.2.2.2.7.3	PEM Harnesses ready for installation	2-Sep-03	28-Apr-03	Yes
1.2.2.2.7.5	All cables done and ready to install	2-Sep-03	26-Aug-03	Yes
1.2.2.2.7.8	VME Crate ready for installation	7-Oct-03	30-Apr-03	Yes
1.3.2.6.3	Begin production of Level 2 Pulsar system	12 Nov 03	12 Nov 03	Yes
1.3.1.6.6	First Prototype TDC available for testing	19-Nov-03	16-Feb-04	Yes
1.2.2.2.7.10	Upstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.11	All EM Timing components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.6	ASD/TB ready for installation	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.7	Downstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.9	TDC boards ready for installation	7-Jan-04	16-Oct-03	Yes
1.3.3.2.3.4	Begin fabrication of Prototype Finder 1/3 board	8-Jan-04	8-Jan-04	CR in process
1.2.1.10.3	First set of Calorimeter phototubes tested	30-Jan-04	20-Oct-03	Yes
1.3.3.8.1.9	Prototype XFT Linker Module available for testing	26-Mar-04	26-Mar-04	CR in process
1.2.1.10.2	1 <sup>st</sup> Calorimeter WLS fiber holder finished	1-Apr-04	17-Feb-04	Yes
1.3.4.4.1.4	Prototype Event Builder hardware arrives	3-Jun-04	31 Mar 04	Yes
1.2.1.10.4	1 <sup>st</sup> CPR module finished and tested	4-Jun-04	15-Mar-04	Yes
1.2.1.10.6	1 <sup>st</sup> CCR module finished and tested	19-Jul-04	2-Mar-04	Yes
1.3.2.9	Pulsar Level 2 subproject ready for installation	4-Aug-04	4-Aug-04	
1.2.1.10.5	2 <sup>nd</sup> set of Calorimeter phototubes tested	6-Aug-04	26-Mar-04	Yes
1.3.5.2.5	Arrival of 0/10 PCs from the vendor	10-Sep-04	10-Sep-04	
1.3.4.5.3	Production Readiness Rev - Event Builder	4-Oct-04	4-Oct-04	
1.3.3.10.3.3	Preproduction XFT Stereo Assoc Modules	29-Nov-04	29-Nov-04	
1.3.6.5	SVT ready for installation	13-Dec-04	13-Dec-04	
1.3.1.12	Beginning of TDC Production	10-Jan-05	10-Jan-05	
1.2.1.10.7	50% Calorimeter CPR Detectors Tested	14-Jan-05	30 June 04	Yes
1.3.4.5.4.4	Arrival of Event Builder hardware	3-Feb-05	3-Feb-05	
1.2.1.10.8	50% Calorimeter CCR Detectors tested	14-Feb-05	30 Dec 04	
1.3.5.5.5	Arrival of 70 L3 & 15 DAQ PCs from the vendor	24-Mar-05	24-Mar-05	
1.3.5.6.5	Arrival of 140/20 PCs from the vendor	24-Mar-05	24-Mar-05	
1.3.3.8.3.3	Begin Production of XFT Linker Modules	24-Mar-05	24-Mar-05	
1.3.3.2.6.9	Begin Production Finder SL7 boards	28-Mar-05	28-Mar-05	
1.3.5.8	Finish Purchase of Computers for L3/DAQ	14-Apr-05	14-Apr-05	
1.2.1.10.9	Final Calorimeter CPR Detector Tested	15-Apr-05	15-Apr-05	
1.2.1.10.10	Final Calorimeter CCR Detector Tested	15-Apr-05	15-Apr-05	
1.2.1.10.11	Final set of Calorimeter phototubes tested	6-May-05	6-June-04	Yes
1.2.1.10.12	End of Central Preshower Project	6-May-05	6-May-05	
1.2.3.5	End of Calorimetry Project: Level 2	6-May-05	6-May-05	
1.3.4.8	Finish Event-Builder Upgrade	31-May-05	31-May-05	
1.3.1.14.16	Data Concentrator Production Completed	29-Jul-05	6-Jun-05	
1.3.3.10.4.6	XFT Production Stereo Modules complete	18-Aug-05	18-Aug-05	
1.3.3.23	XFT Ready for Installation at CDF	29-Sep-05	29-Sep-05	
1.3.1.13.10	TDC Production Board testing complete	30-Sep-05	30-Sep-05	
1.3.1.16	Run 2b TDC Ready for Installation	30-Sep-05	30-Sep-05	
1.3.8	Finish Run 2b Trigger DAQ project	30-Sep-05	30-Sep-05	

#### **IV. PROCUREMENT – P. Lukens**

The production quantity order for single board computers was placed for the Event Builder subproject in June 2004.

#### **V. PROJECT HIGHLIGHTS**

##### **1.2 – Calorimeter**

##### **1.2.1 Central Preshower and Crack Detector – Steve Kuhlmann**

The Central Preshower/Crack Upgrade continued routine full production in June. Twenty-seven Preshower modules have been assembled and tested at ANL, using fiber pigtails produced at MSU. The modules are mapped with a source the same day as assembly and the quality has been excellent. Four tiles out of 1458 (0.27%) have shown low response. We expect these modules will become spares. All of the production spliced fibers have been delivered to MSU from FNAL Lab 7. All of the Dubna module tiles have been delivered to FNAL Lab 8, and tile grooving there has kept up with assembly. INFN has provided 6 technicians and 4 physicists providing additional technical manpower for assembly and checkout at ANL. Rockefeller Univ. also provided two physicists for this purpose.

About 45% of the Crack scintillator has been prepared at FNAL Lab 8. Crack module assembly will begin in July and is expected to take 2-3 weeks. The INFN-purchased HV system was installed in the CDF first floor counting room.

The table below shows the current production status of the CPR and CCR components:

<b>Component</b>	<b>Produced</b>	<b>Total needed</b>	<b>Complete</b>
Preshower tiles	1620	2592	63 %
Preshower spliced fibers	2592	2592	100 %
Preshower fiber pigtails	136	192	71 %
Preshower modules	30	48	63 %
Crack tiles	205	480	43 %
Crack spliced fibers	480	480	100 %
Crack pigtails	12	48	25 %
Crack modules	3	48	6 %
Preshower & Crack clear fiber cables	7	192	4 %
Transition cards	10	96	10 %
PMT boxes	36	48	75 %

##### **1.2.2 Electromagnetic Timing – Dave Toback**

All EM Timing work has been completed. The components installed last year are fully functional and have established an extremely satisfactory operating history.

## **1.3 – Data Acquisition and Trigger**

### **1.3.1 TDC (Time to Digital Converter) – Henry Frisch, Ting Miao**

We have tested a major portion of the TDC-II card. We are working on the Level 1 accepts with 132ns spacing and a test of the card with all the input channels turned off. We have incorporated the Review Committee updates to deal with single bit upsets by reconfiguration.

We have also studied the impact of performing CBLT reads. We will be set to release the updated design when Fermilab places the order. We have supplied a bill-of-material and board pricing on a similar card for the needed quantities. We are studying the ‘beyond-the-baseline’ possibility of collecting seven hits/wire/collision. We are grappling with the challenge of trying to minimize the added latency in the increased size of the data transfer in the FPGA.

### **1.3.2 Level 2 – Ted Liu, Peter Wittich**

The CDF Level 2 Trigger system continues to make progress on the following fronts:

- Pulsar hardware, firmware and VME software,
- PCI and CPU performance studies, and
- S-LINK data format definition for all data paths.

The table below shows the current production status of the Level 2 components:

<b>Component</b>	<b>Produced</b>	<b>Total needed</b>	<b>Complete</b>
Pulsar boards	28	30	93 %
S-Link LSC/LDC cards	20	20	100 %
S-Link PCI cards	6	12	50 %
S-Link fibers	30	30	100 %
AUX cards	20	20	100 %
Hotlink mezzanine cards	20	20	100 %
Taxi mezzanine cards	30	30	100 %
Hotlink/Taxi fibers	120	120	100 %
Fiber splitters	40	60	67 %
L2 decision CPUs	4	6	67 %

All pulsar motherboards have arrived and 28 of them have been fully tested. All 20 pairs of the S-Link LDC/LSC cards have arrived at Fermilab and have been tested satisfactorily. The firmware implementation and testing for various data paths is in progress and system integration and beam testing has already started. Two new Level 2 Decision CPU's have arrived and one has been fully tested with the pulsar boards.

### **1.3.3 XFT (eXtremely Fast Tracker) II – Richard Hughes, Brian Winer (Pat Lukens)**

Work continues on the simulation of the upgraded XFT. Recent developments with respect to the degraded performance of the COT have focused the simulation work on understanding how an upgraded device will perform with both an increase in instantaneous luminosity and a reduction of single hit efficiency due to an aged COT. Work during the month of June was

focused on preparations for the internal and Director's reviews of the project. Cost and schedule development of the proposed new scope of the project was completed.

#### **1.3.4 Event Builder – Bruce Knuteson**

Code implementation continues. The basic messaging framework, using the ACE package, has been implemented. We have begun coding the active objects that will run in the Event Builder Proxy and Scanner CPUs. We appear to be on schedule for having code that will enable us to test the message passing and data throughput during the upcoming shutdown.

#### **1.3.6 SVT (Silicon Vertex Tracker) – Luciano Ristori**

We are not planning to begin work on the Silicon Vertex Tracker trackfitter and merger boards until later in calendar year 2004.

#### **1.3.7 Silicon Detector DAQ Upgrades**

We are not planning to perform any additional work on the Silicon Detector DAQ upgrades until later in calendar year 2004.

### **VI. FINANCIAL STATUS (as of 30 June 2004)**

The baseline cost of the Project is \$10,375K, and consists of the costs for the scope of the Run IIb Project (\$8,702K) plus the closeout costs of the silicon detector upgrade (\$1,673K), which will no longer be constructed.

The following financial table is attached:

**CDF RunIIb Obligations Report** - This report provides a summary, at Level 2, of the outstanding requisitions and purchase orders where money has been committed but for which the Project has not been invoiced. This does not include requisitions in the system that have not had a Fermilab Purchase Order number assigned as of the date of the report. A brief description of the columns included in this report is given below:

- Current Month Total Cost – The cost charged to the project for the reporting month.
- Current Month Obligation – This is the total of the obligations made against the project for the reporting month.
- Year to Date Total Cost – This is the total cost charged to the project in this fiscal year.
- Year to Date Obligations with Indirect – This is the total of the obligations made against the project for this fiscal year.
- Current Purchase Orders Open Commitment – This is the total of the open commitments against the project. It includes open commitments from the current and all prior years.
- Prior Year Total Cost - This is the total cost charged to the project in all prior fiscal years.

The total project cost is simply the sum of the Year-to-Date costs and the Prior Year costs. The total committed and spent is the total project cost plus the Open Commitment value.

# CDF Project Obligations Report Through 30 June 2004

CDF RI1b EQU - JUNE FYO4 IN \$K							
Task Number	Expenditure Category	Current Mth Total Cost	Current Mth Obligation	YTD Total Cost	YTD Obligations W/INDIRECT	Current PO Open Comm	Prior Yr Total Cost
	M&S	1.2	0.4	294.2	349.2	100.9	221.0
	SWF	0.0	0.0	222.1	222.1	0.0	346.1
	OH	0.1	0.0	87.9	87.9	0.0	140.2
	Total 1.1	1.2	0.4	604.2	39.2	100.9	707.3
	M&S	94.3	3.6	170.1	235.2	65.2	0.0
	SWF	20.8	20.8	88.8	88.8	0.0	20.6
	OH	8.3	0.0	36.1	36.1	0.0	6.3
	Total 1.2	123.4	24.4	294.9	360.1	65.2	26.9
	M&S	11.3	48.6	235.7	330.0	228.6	2.9
	SWF	15.7	15.7	83.6	83.6	0.0	0.0
	OH	4.9	0.0	39.3	39.3	0.0	0.5
	Total 1.3	31.9	64.3	358.6	452.9	228.6	3.4
	M&S	1.9	1.9	14.3	14.3	0.0	13.3
	SWF	8.5	8.5	104.5	104.5	0.0	126.7
	OH	2.8	0.0	33.5	33.5	0.0	40.1
	Total 1.4	13.2	10.3	152.3	152.3	0.0	180.1
Total Project	M&S	108.6	54.5	714.3	230.3	394.7	237.2
	SWF	44.9	44.9	499.1	499.1	0.0	493.5
	OH	16.1	16.1	196.7	196.7	0.0	187.0
Grand Total		169.7	115.5	1410.1	926.1	394.7	917.7

**TOTAL PROJECT COST (INCEPTION TO DATE): 2327.8**

## **VII. VARIANCE ANALYSIS – P. Lukens**

The most significant variance the Project has from the baseline schedule is in the TDC and XFT development. This will be best remedied by additional manpower from the collaboration, and we are currently trying to secure this effort. We anticipate formalizing new schedules for these projects prior to the July Director's Review.

## **VIII. BASELINE CHANGES**

No Change Control action documents were approved during June 2004.

## **IX. FUNDING PROFILES**

The funding profile is shown below:

	Funding Plan in Current Year \$K				
	FY02	FY03	FY04	FY05	Total
DOE MIE	\$ 3,460	\$ 3,509	\$ 1,673	\$ 1,732	\$ 10,375
DOE R&D	\$ 1,670	\$ 480			\$ 2,150
Foreign Contributions	\$ 39	\$ 342	\$ 252	\$ 10	\$ 643
U.S. Universities	\$ 24	\$ 225	\$ 103	\$ 26	\$ 378
Total	\$ 5,193	\$ 4,556	\$ 2,028	\$ 1,768	\$ 13,545